Appendix A. Unit Conversion Chart

Table A-1. Metric - English unit conversions.

	English Units	Metric Units	To Convert	Example
Distance	Miles (mi)	Kilometers (km)	1 mi = 1.61 km 1 km = 0.62 mi	3 mi = 4.83 km 3 km = 1.86 mi
Length	Inches (in) Feet (ft)	Centimeters (cm) Meters (m)	1 in = 2.54 cm 1 cm = 0.39 in 1 ft = 0.30 m 1 m = 3.28 ft	3 in = 7.62 cm 3 cm = 1.18 in 3 ft = 0.91 m 3 m = 9.84 ft
Area	Acres (ac) Square Feet (ft^2) Square Miles (mi^2)	Hectares (ha) Square Meters (m^2) Square Kilometers (km^2)	1 ac = 0.40 ha 1 ha = 2.47 ac 1 ft^2 = 0.09 m^2 1 m^2 = 10.76 ft^2 1 mi^2 = 2.59 km^2 1 km^2 = 0.39 mi^2	3 ac = 1.20 ha 3 ha = 7.41 ac 3 ft^2 = 0.28 m^2 3 m^2 = 32.29 ft^2 3 mi^2 = 7.77 km^2 3 km^2 = 1.16 mi^2
Volume	Gallons (gal) Cubic Feet (ft^3)	Liters (L) Cubic Meters (m^3)	1 gal = 3.78 L 1 L= 0.26 gal 1 ft^3 = 0.03 m^3 1 m^3 = 35.32 ft^3	3 gal = 11.35 L 3 L = 0.79 gal 3 ft^3 = 0.09 m^3 3 m^3 = 105.94 ft^3
Flow Rate	Cubic Feet per Second (cfs)[a]	Cubic Meters per Second (m^3/sec)	1 cfs = 0.03 m^3/sec 1 m^3/sec = 35.31cfs	3 ft^3/sec = 0.09 m^3/sec 3 m^3/sec = 105.94 ft^3/sec
Concentration	Parts per Million (ppm)	Milligrams per Liter (mg/L)	1 ppm = 1 mg/L[b]	3 ppm = 3 mg/L
Weight	Pounds (lbs)	Kilograms (kg)	1 lb = 0.45 kg 1 kg = 2.20 lbs	3 lb = 1.36 kg 3 kg = 6.61 lb
Temperature	Fahrenheit (°F)	Celsius (°C)	°C = 0.55 (F - 32) °F = (C x 1.8) + 32	3 °F = -15.95 °C 3 °C = 37.4 °F

[a] 1 cfs = 0.65 million gallons per day; 1 million gallons per day is equal to 1.55 cfs.

[b] The ratio of 1 ppm = 1 mg/L is approximate and is only accurate for water.

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Appendix B. State and Site-Specific Standards and Criteria

Water Quality Standards Applicable to Salmonid Spawning Temperature

Water quality standards for temperature are specific numeric values not to be exceeded during the salmonid spawning and egg incubation period, which varies with species. For spring spawning salmonids, the default spawning and incubation period recognized by DEQ is generally from March 15th to July 1st each year (Grafe et al. 2002). Fall spawning can occur as early as August 15th and continue with incubation on into the following spring up to June 1st. As per IDAPA 58.01.02.250.02.e.ii., the water quality criteria that need to be met during that time period are:

> 13^{o}C as a daily maximum water temperature,
>
> 9^{o}C as a daily average water temperature.

For the purposes of a temperature TMDL, the highest recorded water temperature in a recorded data set (excluding any high water temperatures that may occur on days when air temperatures exceed the 90th percentile of highest annual MWMT air temperatures) is compared to the daily maximum criterion of 13^{o}C. The difference between the two water temperatures represents the temperature reduction necessary to achieve compliance with temperature standards.

Natural Background Provisions

For potential natural vegetation temperature TMDLs, it is assumed that natural temperatures may exceed these criteria during these time periods. If potential natural vegetation targets are achieved yet stream temperatures are warmer than these criteria, it is assumed that the stream's temperature is natural (provided there are no point sources or human induced ground water sources of heat) and natural background provisions of Idaho water quality standards apply. As per IDAPA 58.01.02.200.09:

> *When natural background conditions exceed any applicable water quality criteria set forth in Sections 210, 250, 251, 252, or 253, the applicable water quality criteria shall not apply; instead, pollutant levels shall not exceed the natural background conditions, except that temperature levels may be increased above natural background conditions when allowed under Section 401.*

Section 401 relates to point source wastewater treatment requirements. In this case if temperature criteria for any aquatic life use is exceeded due to natural conditions, then a point source discharge cannot raise the water temperature by more than 0.3^{o}C (IDAPA 58.01.02.401.03.a.v.).

Estimate of Bankfull Channel Width

The only factor not developed from the aerial photo work presented above is channel width (i.e., NSDZ or Bankfull Width). Accordingly, this parameter must be estimated from available information. Leopold et. al (1964) proposed that channel width tends to increase linearly with increases in drainage area. Rosgen (1996) reported that bankfull width can be estimated as a function of width to depth ratio and cross-sectional area. For this calculation, the following equation is used:

$$BFW = \sqrt{W:D \cdot A_{bf}}$$

Where: A_{bf} is the Bankfull Cross-Sectional Area (ft^2)
W:D is the width to depth ratio

Figure B-1 illustrates the regional curve for bankfull cross-sectional area (A_{bf}) and drainage area (DA) in the Upper Salmon River Basin (USGS Professional Paper 870-A). Deep Creek was divided into several sections. GIS was used to calculate the upstream contributing area (DA) at the lower end of each of these sections. Upstream contributing areas between these locations were estimated through interpolation. Bankfull Cross-Sectional Area was then estimated using the relationship presented in Figure B-1. Width to depth ratio values were assigned values derived from published ranges for level I stream types (Rosgen 1996). Target Bankfull Width values for each of these Rosgen Level I Stream Types were estimated using the equation listed above (Figure B-2). Target values developed during this exercise were used to develop channel width conditions used in Effective Shade Calculations.

Level I Stream Type	Width to Depth (W:D)
A	8
B	19
C	30
D	N/A
E	7
F	28
G	8

Figure B-1. Bankfull Cross-Sectional Area as a function of Drainage Area in the Upper Salmon River Basin, Idaho (Emmett 1975)

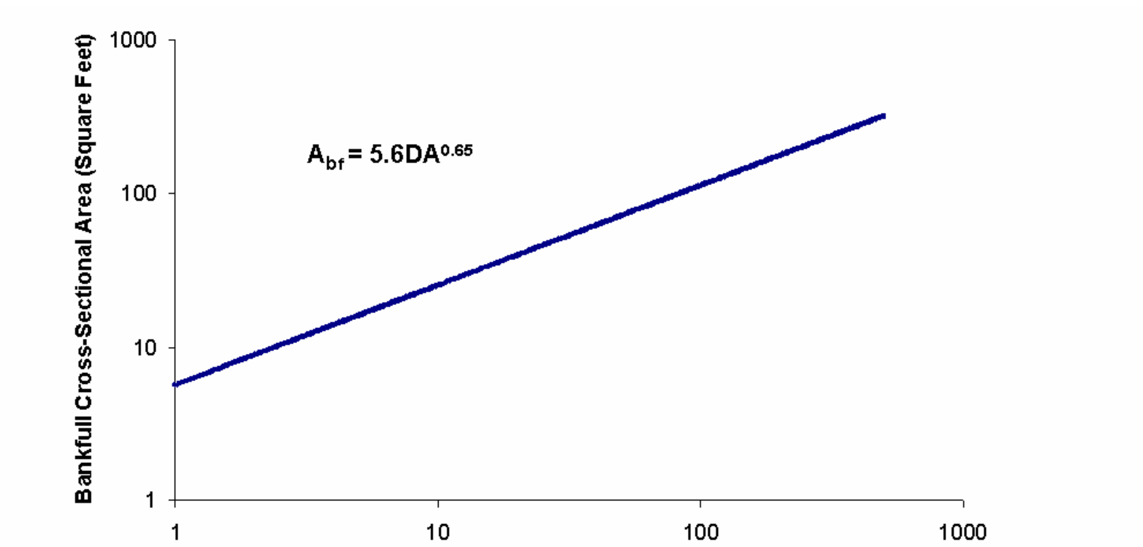
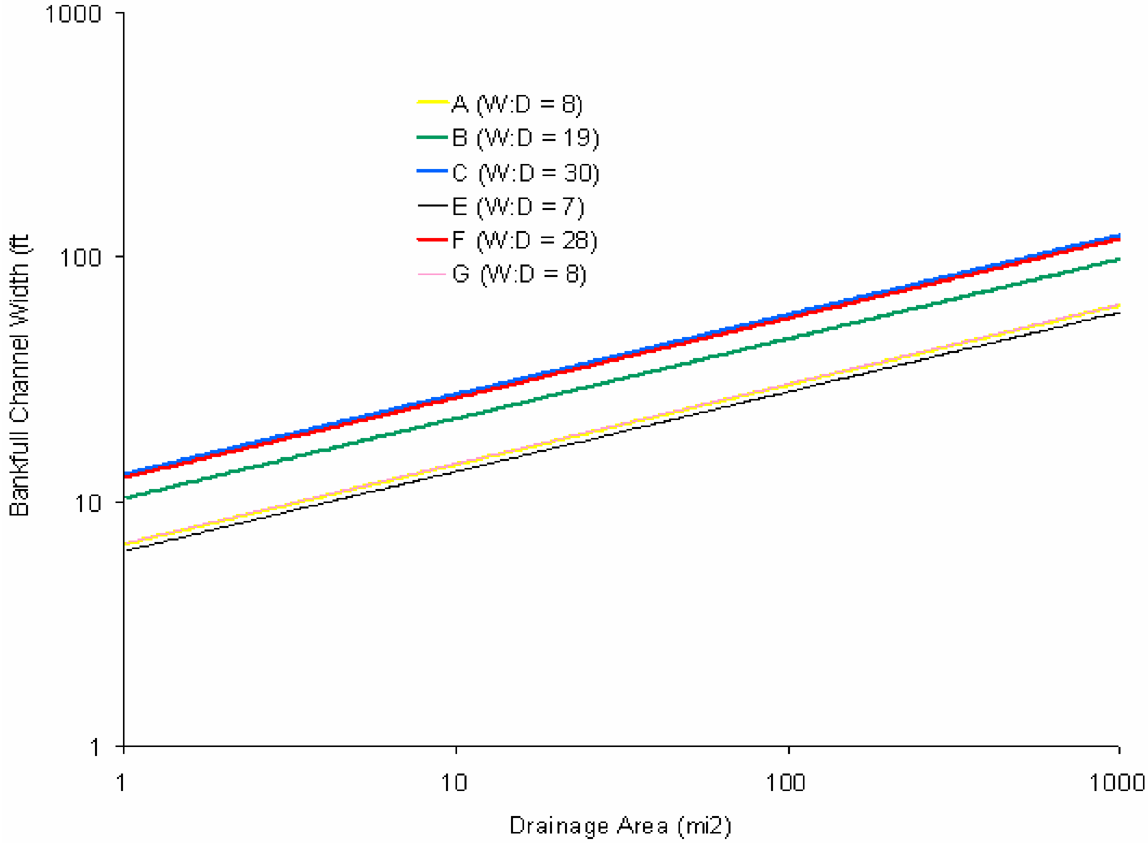


Figure B-2. Bankfull Width as a Function of Width to Depth Ratio and Drainage Area



Accordingly, Rosgen level I classification can be used to estimate approximate bankfull width conditions through applying the equation listed above (Figure B-2). The Rosgen level I classification for Deep Creek were estimated to be Class C. The drainage area for Deep Creek is roughly 181 mi^2 with 129 mi^2 above Brown Creek. Deep Creek natural stream widths below Brown Creek (Rosgen C type) were likely in the neighborhood of 20m (66ft) as determined from Figure B-2. The drainage area for McArthur Lake and Deep Creek above Trail Creek is about 41 mi^2. Therefore, natural stream widths from McArthur Lake to Brown Creek (Rosgen B & C types) were determined to be about 10m (33ft).

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Appendix C. Data Sources

Table C-1. Data sources for Lower Kootenai and Moyie River Subbasin Assessment.

Water Body	Data Source	Type of Data	When Collected
Boundary Creek and Deep Creek	DEQ Coeur d'Alene Regional Office	Pathfinder effective shade and stream width	March 2005
Boundary Creek and Deep Creek	DEQ State Technical Services Office	Aerial Photo Interpretation of existing shade and stream width estimation	February-March 2005
Boundary Creek and Deep Creek	DEQ IDASA Database	Temperature	1998-2001

Table C-2. Temperature loggers deployed in the Lower Kootenai and Moyie River Subbasins between 1998 and 2001.

Site ID	Stream	Dates deployed
1998SCDATL0001	Boundary Creek	07/30/1998-10/21/1998
1998SCDATL0002	Boundary Creek	07/30/1998-10/21/1998
1998SCDATL0003	Grass Creek	07/31/1998-10/19/1998
1998SCDATL0004	Grass Creek	07/30/1998-10/21/1998
1998SCDATL0005	Blue Joe Creek	07/30/1998-10/21/1998
1998SCDATL0006	Skin Creek	06/20/1998-09/23/1998
1998SCDATL0007	Deer Creek	06/20/1998-10/21/1998
1998SCDATL0008	Deer Creek	06/20/1998-10/21/1998
1998SCDATL0009	Deer Creek	06/20/1998-10/21/1998
1998SCDATL0010	Meadow Creek	06/20/1998-10/21/1998
2000SCDATL0001	Ball Creek	06/23/2000-10/01/2000
2000SCDATL0003	Blue Joe Creek	06/22/2000-10/17/2000
2000SCDATL0004	Boulder Creek	05/25/2000-10/04/2000
2000SCDATL0005	Boundary Creek	05/26/2000-10/03/2000
2000SCDATL0006	Brown Creek	05/25/2000-10/02/2000
2000SCDATL0007	Caribou Creek	05/23/2000-10/02/2000
2000SCDATL0008	Cascade Creek	05/23/2000-10/02/2000
2000SCDATL0009	Cow Creek	05/26/2000-10/03/2000
2000SCDATL0010	Curley Creek	05/27/2000-10/04/2000
2000SCDATL0011	Dodge Creek	05/23/2000-10/02/2000
2000SCDATL0012	Fall Creek	05/23/2000-06/14/2000
2000SCDATL0013	Fisher Creek	06/23/2000-10/03/2000
2000SCDATL0014	Fleming Creek	05/24/2000-10/04/2000
2000SCDATL0015	Gillion Creek	05/24/2000-10/04/2000
2000SCDATL0016	Grass Creek	06/23/2000-09/17/2000
2000SCDATL0017	Long Canyon Creek	07/21/2000-08/27/2000
2000SCDATL0018	Long Canyon Creek	06/23/2000-10/03/2000
2000SCDATL0020	Miller Creek	05/24/2000-10/04/2000
2000SCDATL0021	Mission Creek	05/24/2000-10/04/2000
2000SCDATL0022	Parker Creek	06/23/2000-10/03/2000
2000SCDATL0023	Parker Creek	07/21/2000-08/27/2000
2000SCDATL0024	Rock Creek	05/24/2000-10/04/2000

2000SCDATL0025	Skin Creek	05/27/2000-10/04/2000
2000SCDATL0026	Smith Creek	06/23/2000-10/03/2000
2000SCDATL0027	Smith Creek	05/26/2000-08/03/2000
2000SCDATL0028	Trial Creek	05/23/2000-10/02/2000
2000SCDATL0029	Trout Creek	06/23/2000-10/03/2000
2000SCDATL0030	Twentymile Creek	05/25/2000-10/02/2000
2000SCDATL0032	Boulder Creek	05/25/2000-07/15/2000
2000SCDATL0033	Mission Creek	05/24/2000-10/03/2000
2000SCDATL0034	Myrtle Creek	05/23/2000-10/02/2000
2000SCDATL0035	Round Prairie Creek	05/24/2000-10/04/2000
2000SCDATL0036	Ruby Creek	05/23/2000-10/02/2000
2000SCDATL0037	Snow Creek	05/23/2000-10/02/2000
2000SCDATL0038	Deep Creek	07/20/2000-08/27/2000
2000SCDATL0039	Deep Creek	07/21/2000-08/26/2000
2000SCDATL0040	Deep Creek	07/21/2000-09/12/2000
2000SCDATL0041	Deep Creek	07/21/2000-08/26/2000
2000SCDATL0042	Deep Creek	07/21/2000-09/12/2000
2000SCDATL0043	Deep Creek	07/21/2000-08/26/2000
2000SCDATL0044	Deep Creek	05/25/2000-10/02/2000
2001SCDATL0001	Fisher Creek	07/03/2001-08/12/2001
2001SCDATL0002	Myrtle Creek	07/03/2001-10/10/2001
2001SCDATL0003	Mission Creek	07/04/2001-10/09/2001
2001SCDATL0004	Long Canyon Creek	07/03/2001-10/10/2001
2001SCDATL0005	Boundary Creek	07/03/2001-10/10/2001
2001SCDATL0006	Skin Creek	07/04/2001-10/09/2001
2001SCDATL0008	Brass Creek	07/04/2001-10/09/2001
2001SCDATL0009	Copper Creek	07/04/2001-10/09/2001
2001SCDATL0010	Davis Creek	07/04/2001-10/09/2001
2001SCDATL0011	East Fork Deer Creek	07/04/2001-10/09/2001
2001SCDATL0012	West Fork Deer Creek	07/04/2001-10/09/2001
2001SCDATL0013	Gillion Creek	07/04/2001-10/09/2001
2001SCDATL0016	Upper Meadow Creek	07/02/2001-10/09/2001
2001SCDATL0017	Miller Creek	07/04/2001-10/09/2001
2001SCDATL0018	Placer Creek	07/04/2001-10/09/2001
2001SCDATL0019	Spruce Creek	07/04/2001-10/09/2001
2001SCDATL0022	Canuck Creek	07/07/2001-10/09/2001
2001SCDATL0023	Faro Creek	01/04/2001-10/08/2001
2001SCDATL0025	Trout Creek	07/03/2001-10/10/2001
2001SCDATL0026	Trout Creek	07/03/2001-10/10/2001
2001SCDATL0027	Ball Creek	07/03/2001-08/16/2001
2001SCDATL0029	Parker Creek	07/02/2001-10/10/2001
2001SCDATL0031	Grass Creek	07/03/2001-10/10/2001
2001SCDATL0032	Blue Joe Creek	07/03/2001-10/10/2001
2001SCDATL0033	Keno Creek	07/04/2001-10/09/2001
2001SCDATL0034	Wall Creek	07/02/2001-08/04/2001
2001SCDATL0036	Meadow Creek	07/02/2001-10/09/2001
2001SCDATL0037	Deer Creek	07/04/2001-10/09/2001
2001SCDATL0039	Round Prairie Creek	07/04/2001-10/09/2001

Figure C-1. Boundary Creek Full Season Temperature Data Collected Near USGS Gage (DEQ Logger Site 2000SCDATL0005).

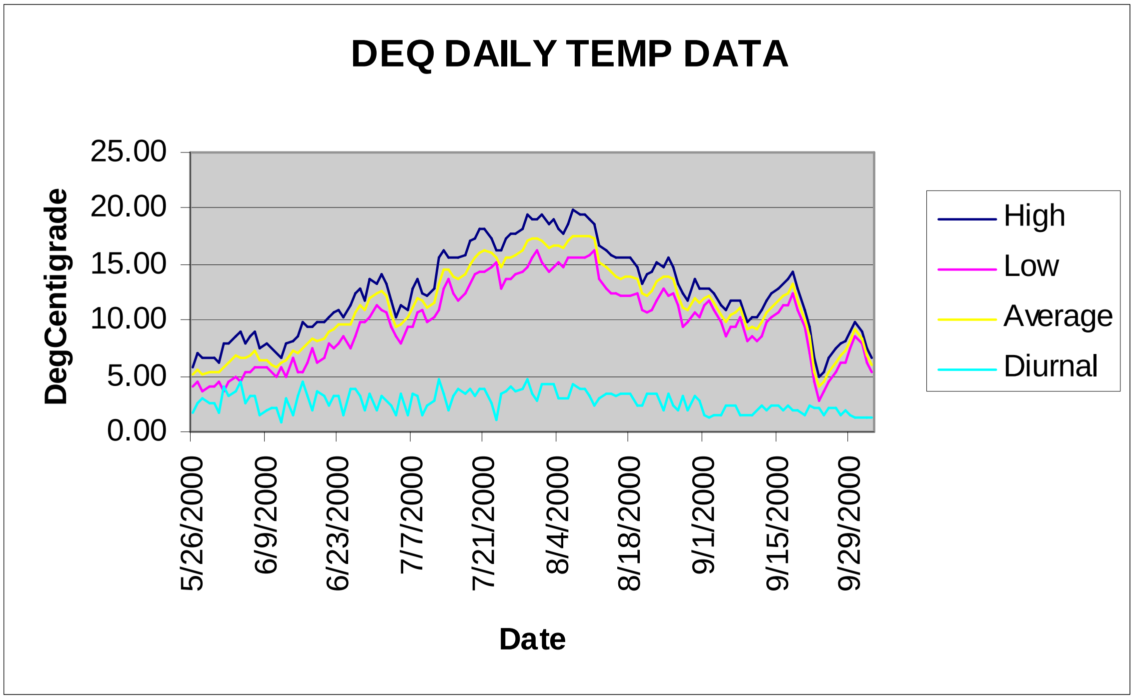


Figure C-2. Upper Boundary Creek Partial Season Temperature Data Recorded at U.S./Canada Border (DEQ Logger Site 1998SCDATL0001).

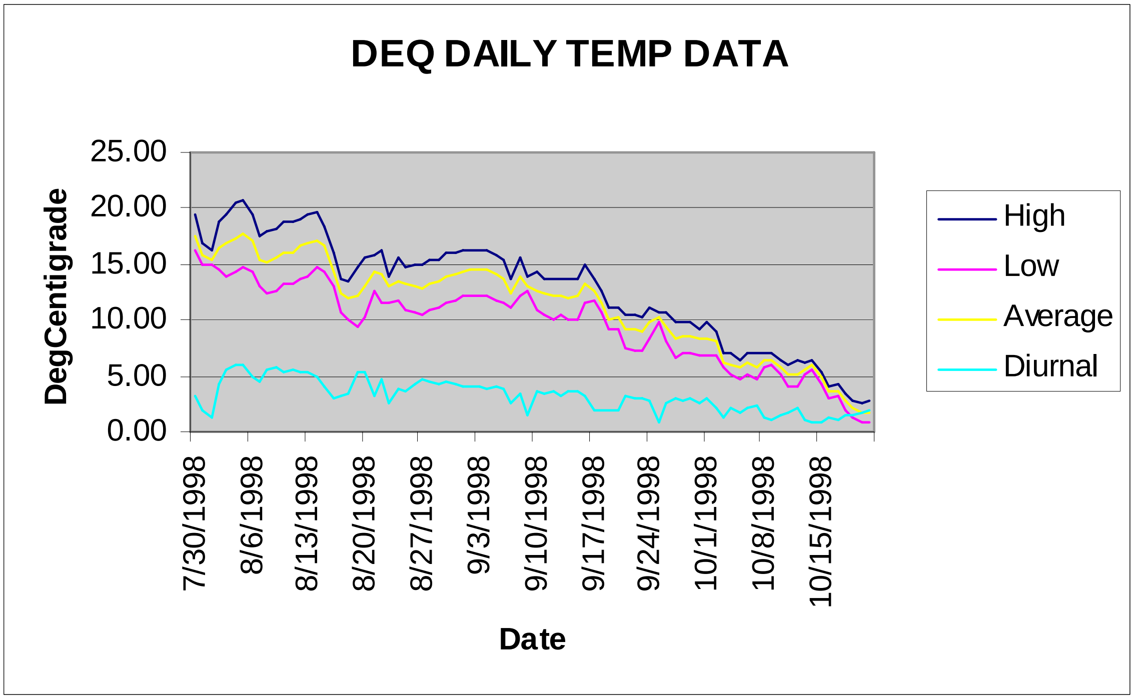


Figure C-3. Boundary Creek Partial Season Temperature Data Recorded Near USGS Gage Station (DEQ Logger Site 1998SCDATL0002).

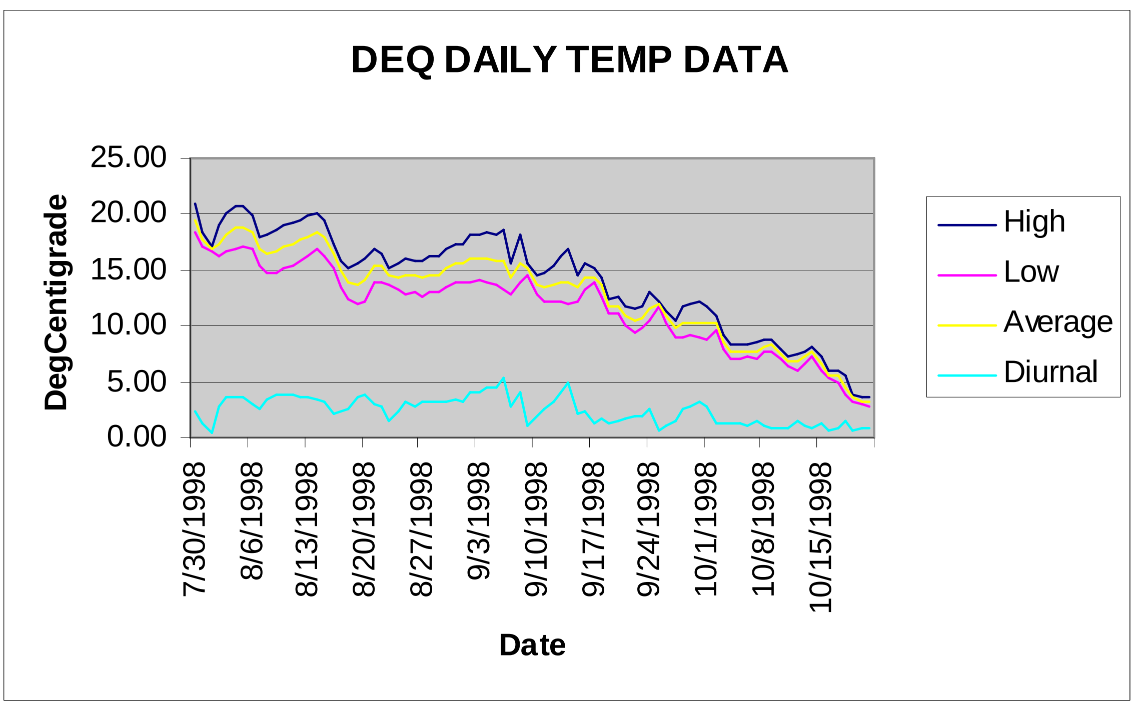


Figure C-4. Boundary Creek Partial Season Temperature Data Recorded Near USGS Gage Station (DEQ Logger Site 2001SCDATL0005).

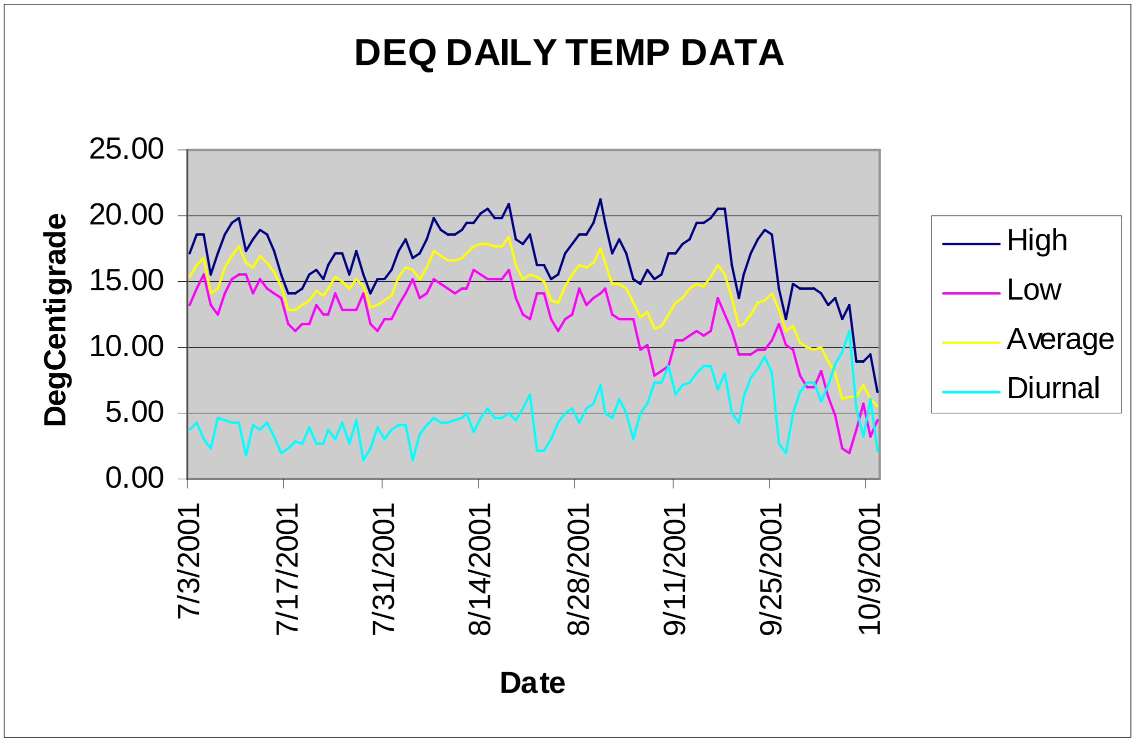


Figure C-5. Deep Creek Full Season Temperature Data Recorded Below Ruby Creek Confluence (DEQ Logger Site 2000SCDATL0044).

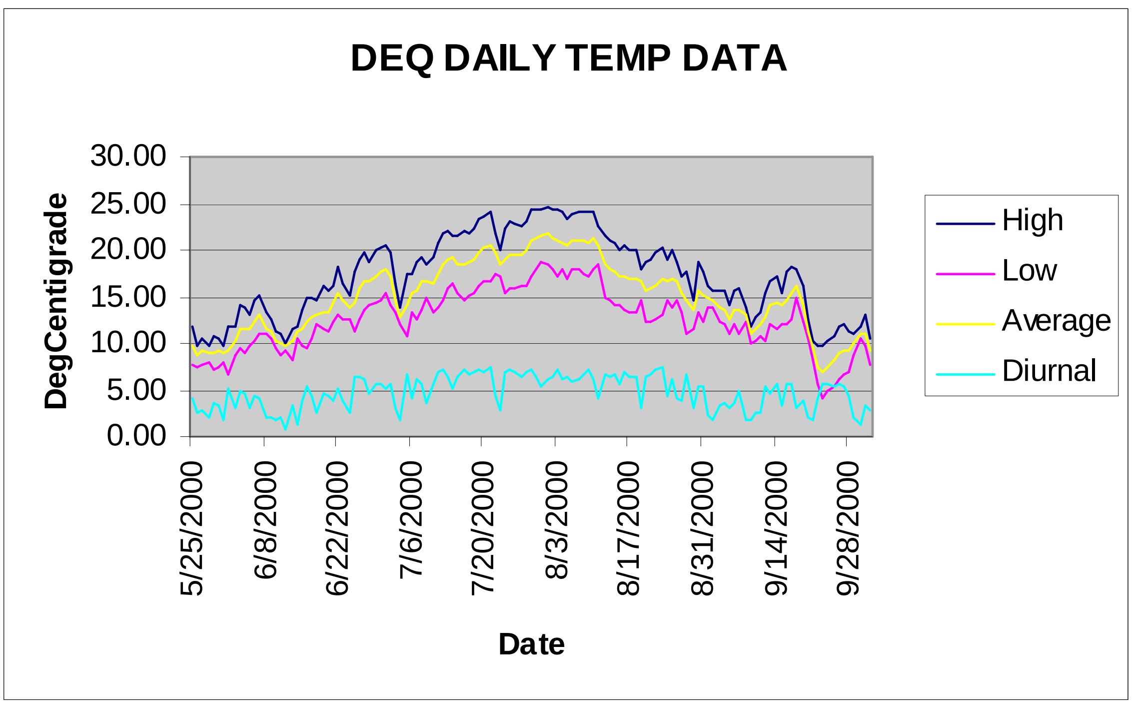


Figure C-6. Deep Creek Partial Season Replicate Series Temperature Data (DEQ Logger Site 2000SCDATL0042).

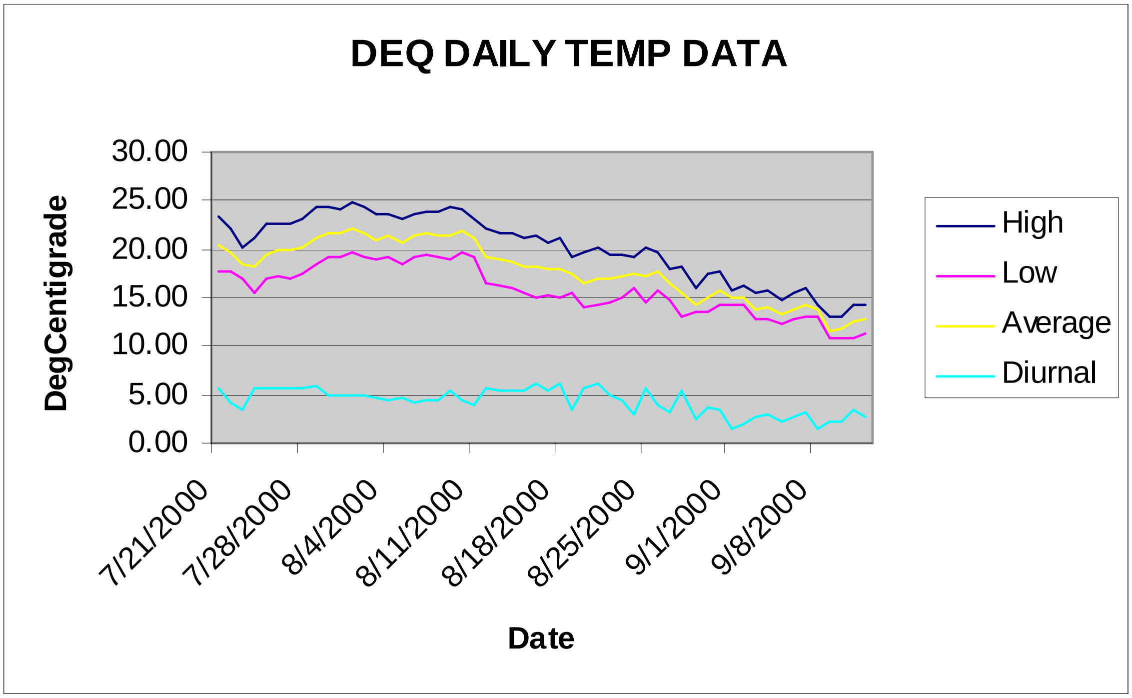


Figure C-7. Deep Creek Partial Season Replicate Series Temperature Data (DEQ Logger Site 2000SCDATL0041).

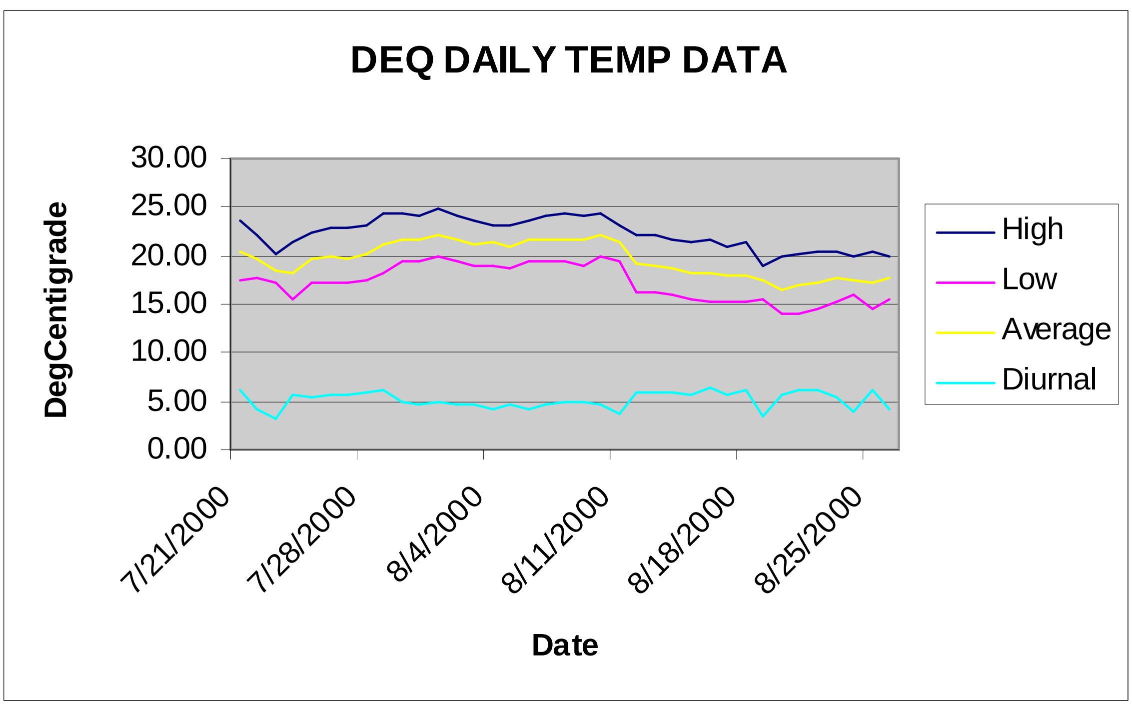


Figure C-8. Deep Creek Partial Season Replicate Series Temperature Data (DEQ Logger Site 2000SCDATL0040).

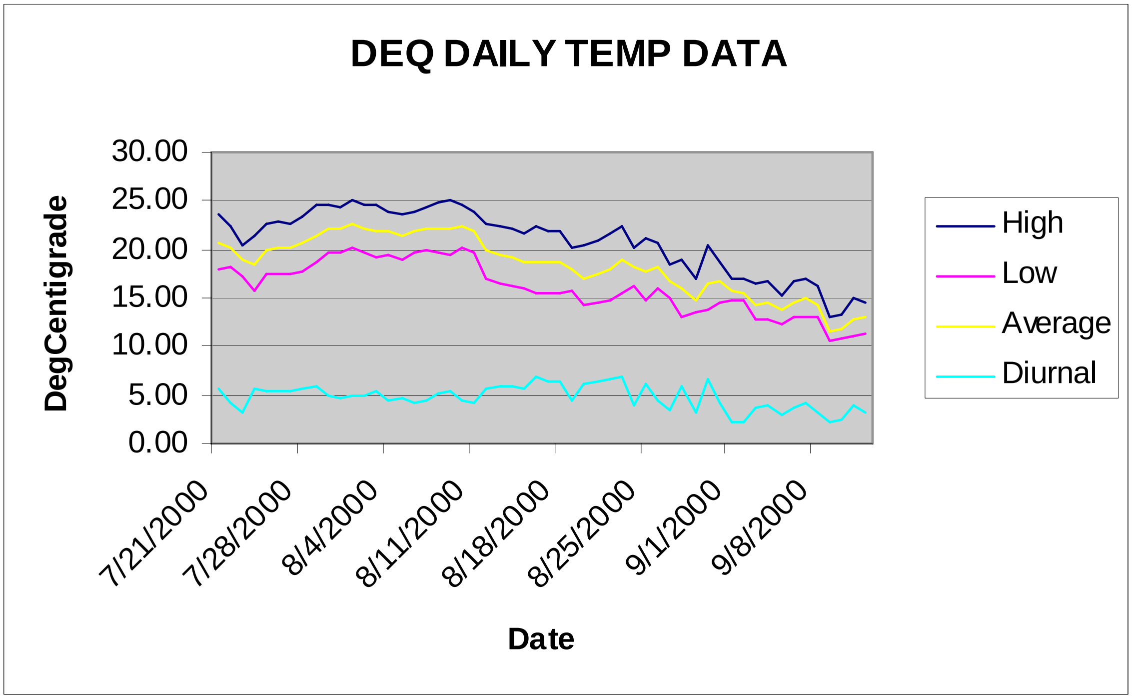


Figure C-9. Deep Creek Partial Season Replicate Series Temperature Data (DEQ Logger Site 2000SCDATL0039).

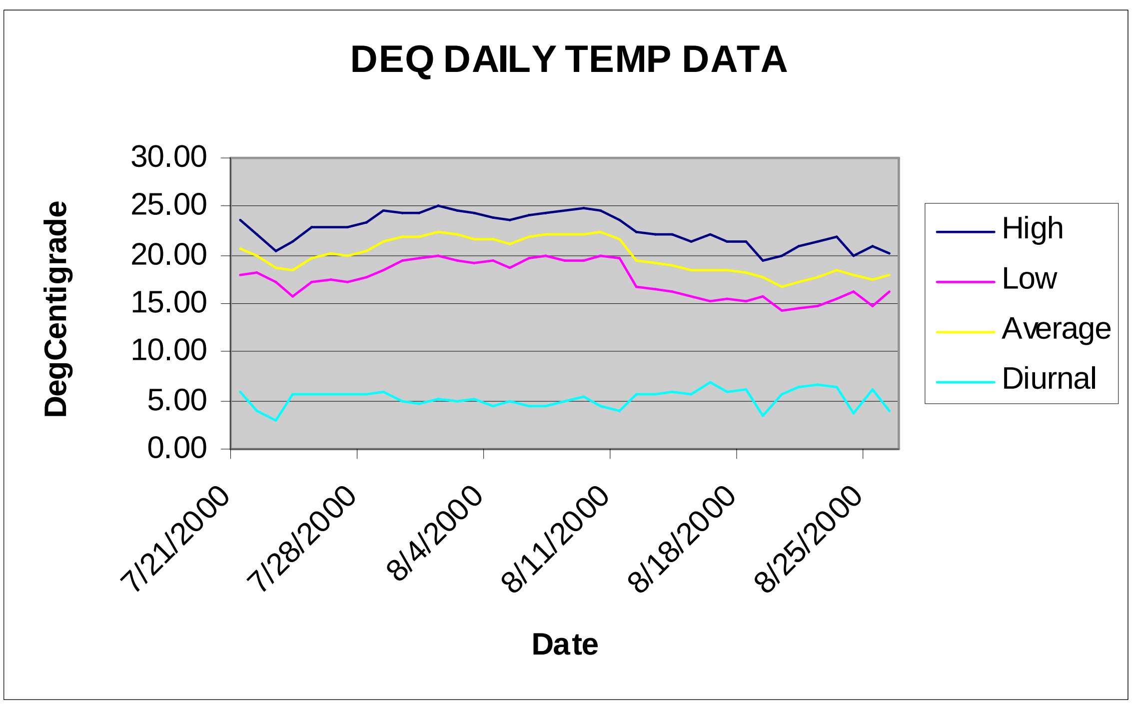
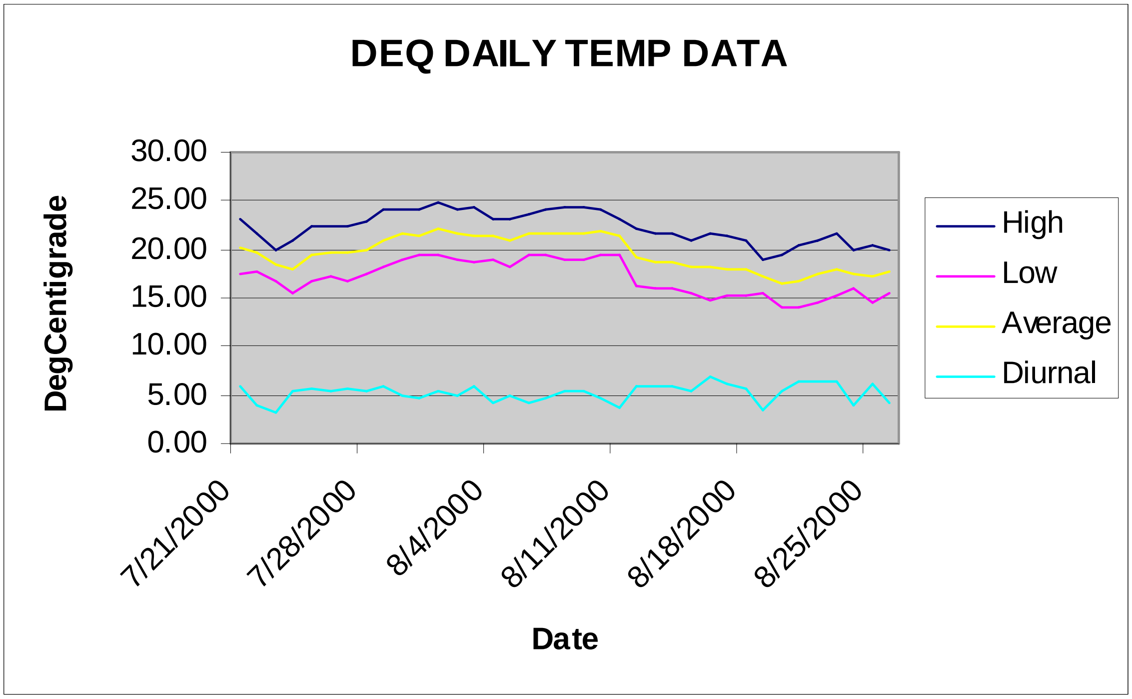


Figure C-10. Deep Creek Partial Season Replicate Series Temperature Data (DEQ Logger Site 2000SCDATL0038).



Appendix D. Distribution List

Appendix E. Public Comments

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Appendix F. Sediment Model Assumptions and Documentation

Background:

In the panhandle region of Idaho, sediment is the pollutant of concern in the majority of water quality limited streams. The lithology, or terrain of the region, most often governs the form the sediment takes. Two major types of terrain dominate in northern Idaho. These are the meta-sedimentary Belt Supergroup and granitics present either in the Kaniksu batholith or in smaller intrusions such as the Round Top Pluton and the Gem Stocks. In some locations Columbia River Basalt formations are important, but these tend to be to the south and west; primarily on the Coeur d'Alene Indian Reservation. Granitics mainly weather to sandy materials, but also weather to pebbles or larger-sized particles. Pebbles and larger particles with significant amounts of sand remain in the higher gradient stream bedload. The Belt terrain produces silt size particles, pebbles, and larger particles. Silt particles are transported to low gradient reaches, while the larger particles comprise the majority of the higher gradient stream bedload. Basalts erode to silt and particles similar in size to the Belt terrain. Large basalt particles are less resistant and weather to smaller particles.

Any attempt to model the sediment output of watersheds will provide relative, rather than exact, sediment yield. The model documented here attempts to account for all significant sources of sediment separately. This approach is used to identify the primary sources of sediment in a watershed. Identification will be useful as implementation plans designed to remedy these sources are developed. If additional investigation indicates that sources quantified as minor are not, the model input can be altered to incorporate this new information.

Model Assumptions:

Land use:

The sediment model attempts to account for all sources of sediment by partitioning these sources into broad categories.

Agriculture

Revised Universal Soil Loss Equation version 2 (RUSLE 2) is the correct model for agricultural land within the basin as it accounts for production and delivery of fine-grained sediment. Two profiles were constructed for the basin to account for the two observed agricultural settings, valley agriculture and bench agriculture. Valley agriculture was delineated as the agricultural land located within the Kootenai River basin valley bottom and maintained for crop production. Areas of bench agriculture are located above the floodplain of the Kootenai River in gently sloping to flat segmented parcels and commonly surround by minor vegetation.

Forest (Natural Background)

Sediment yield coefficients measured in-stream on geologies of north central Idaho cover production and delivery from forested areas. These sediment yield coefficients reflect both fine and coarse sediment.

Forested areas were given the average sediment yield coefficient for metasediment Belt Supergroup and granitic geologies. Forested areas included fully stocked and not fully stocked by Forest Practice Act standards. Applying the sediment yield coefficient to all forested areas provided for a conservative estimate (overestimate).

Stream bank erosion

Erosion from stream bank lateral recession can be estimated with the direct volume method (Erosion and Sediment Yield in Channels Workshop 1983). The volume of sediment was calculated from field measurements and lateral recession rates. Stream bank assessments were made by the Kootenai-Shoshone Soil and Water Conservation District in 2001 and 2002. Stream bank erosion surveys were limited to agricultural areas only.

Forest Roads

Road erosion scores from the Cumulative Watershed Effects (CWE) program was applied to 200 feet of the road on either side of a stream crossing, not tied to total road mileage. Roads which do not cross the stream but are located within 200 feet of the stream were also modeled.

The use of the McGreer relationship between the CWE score and road surface erosion is a valid estimate of road surface fines production and yield. In the case of Belt terrain, it is a conservative estimate (overestimate).

Sediment Delivery:

100% delivery from forestlands with sediment yield coefficients measured in-stream on geologies of north central Idaho.

100% delivery from agriculture lands estimated with RUSLE 2 were applicable.

100% delivery from all road miles up to 200 feet from a stream crossing as estimated by the McGreer relationship.

Fine and coarse materials are delivered at the same rate from fill failures and from erosion resulting from road encroachment and bank erosion.

Model Approach:

Land use is the primary broad category. Land use types are divided into bench and valley agriculture, forest, disturbed, forest roads, stream bank erosion, railroad and pipeline.

Sediment yields from agriculture lands that received any tillage are modeled with RUSLE 2.

Equation 1: A = (R)(K)(LS)(C)(D) tons per acre per year where:
: A is the average annual soil loss from sheet and till erosion
: R is climate erosivity
: K is the soil erodibility
: LS is the slope length and steepness
: C is the cover management
: D is the support practices

The RUSLE 2 does not take into account stream bank erosion, gully erosion, or scour erosion. The RUSLE 2 applies to cropland, pasture, hayland or other land that has some vegetation improvement by tilling or seeding. Based on the soils, the characteristics of the agriculture, and the slope, sediment yields were developed from the agricultural lands of each watershed. The RUSLE 2 develops values that reflect the amount of sediment eroded and delivered to the active channel of the stream system annually.

All coefficients are expressed as tons per acre per year (t/a/y) and are applied to the acreage of each land type developed from the Geographical Information System (GIS) coverage. All land uses are displayed with estimated sediment delivery. Land use sediment delivery is then totaled.

Forest roads were modeled using data developed with the Cumulative Watershed Effects (CWE) protocol. A watershed CWE score was used to estimate surface erosion from the road surface. Forest road sediment yield was estimated using the relationship between the CWE score and the sediment yield per mile of road (Figure F-1). The relationship was developed for roads on a Kaniksu granitic terrain in the LaClerc Creek watershed, figure F-1 (McGreer 1998). Its application to roads on a Belt terrain conservatively estimate sediment yields from these systems. The watershed CWE score was used to develop sediment tons per acre, which was multiplied by the estimated road acreage affecting the stream. It was assumed that all sediment was delivered to the stream system. This is a conservative estimate of actual delivery.

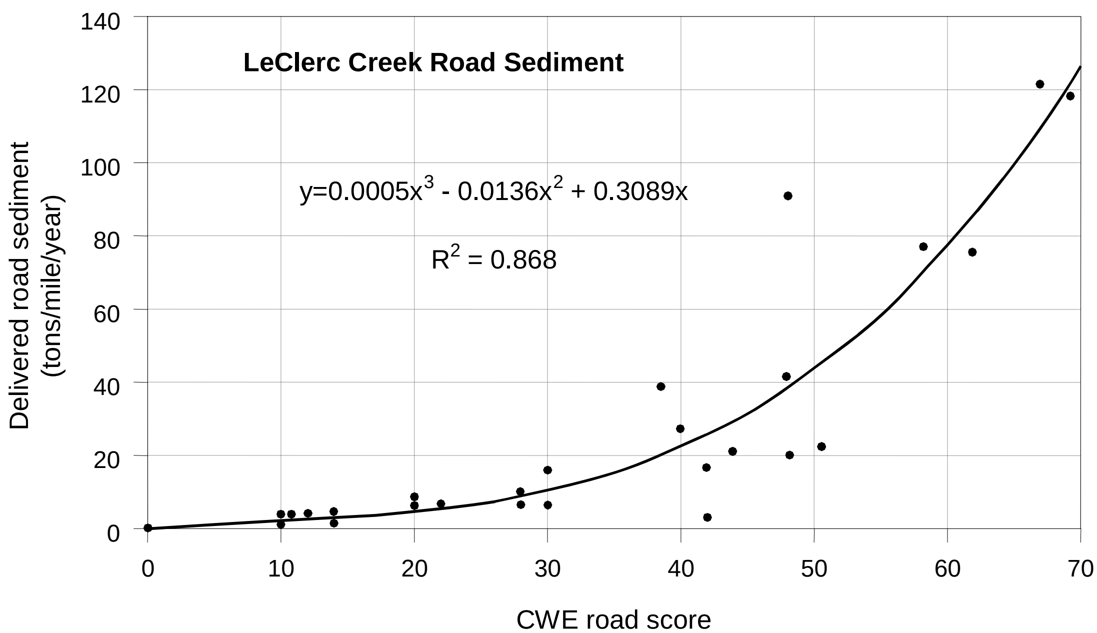

Figure F-1. Sediment export from roads based on CWE scores.

Figure F-1 Sediment Export of Roads Based on Cumulative Watershed Effects Scores
Forest road failure was estimated from actual CWE road fill failure and delivery data. These failures were interpreted as the primary result of large discharge events, which occur on a 10 – 15 year return period (McClelland et al. 1997). The estimates were annualized, by dividing the measured values by 10. Data are typically from a subset of the roads in a watershed. The sediment delivery value was scaled using a factor reflecting the watershed road mileage divided by the road mileage assessed. The sediments delivered through this mechanism contained both fine material (including, and smaller than, pebbles) and coarse material (pebbles and larger sizes). The percentages of fine and coarse particles were estimated using the described characteristics of the soil series found in the watershed. The weighted average of the fines and coarse composition of the B and C soil horizons to a depth of 36 inches were developed using the soils GIS coverage STATSGO, which contains the soils composition data provided by soils survey documents. The B and C horizons' composition was used because these are the strata from which forest roads are normally constructed. Based on the developed soil composition percentage and the estimated probable yield, the tons of fine and coarse material delivered to the streams by fill failure was calculated. This approach assumes equal delivery of fine and coarse materials.

Roads cause stream sedimentation by an additional mechanism. The presence of roads in the floodplain of a stream most often interferes with the stream's natural tendency to seek a steady state gradient. During high discharge periods, the constrained stream often erodes at the roadbed, or, if the bed is armored, erodes at the opposite bank or its bed. The erosion resulting from a road- imposed gradient change results in stream sedimentation. The model assumes the roads causing gradient effects to be those within 200 feet of the stream. The model then assumes 0.25-inch erosion per lineal foot of bed and bank up to three feet in height. The 0.25- inch cross-section erosion is assumed to be uniform over the bed and banks. The erosion rate was selected from a model curve of erosion in inches compared to modeled sediment yields from a channel 10 feet in width. The stream cross-section used was based on the weighted bank full width for all measurements made of streams in the Beneficial Use Reconnaissance and Use Attainability programs. The erosion is determined from the soil types in the basin with the weighted percentages of fine and coarse material. A bulk soil density of 2.6 grams per cubic centimeter is used to convert soil volume into weight in tons. The tons of fine and coarse material are totaled for all road segments within 50 lineal feet of the stream. The bulk of this erosion is assumed to occur during large discharge events which occur on a 10 - 15-year return period (McClelland et. al 1997). The estimates, therefore, are annualized by dividing the measured values by 10.

Estimates of bank recession are appropriate primarily along low gradient Rosgen B and C channels (Rosgen 1985). The direct volume method, as discussed in the Erosion and Sediment Yield Channel Evaluation Workshop (1983), was employed to make the estimates. The method relies on measurements of eroding bank length, lateral recession rate, soil type, and particle size to make these estimates. A field crew collected these data. The fine and coarse material fractions of the bank material based on STATSGO GIS coverage are used to estimate fine and coarse material delivery to the stream. These values are added into the watershed sediment load.

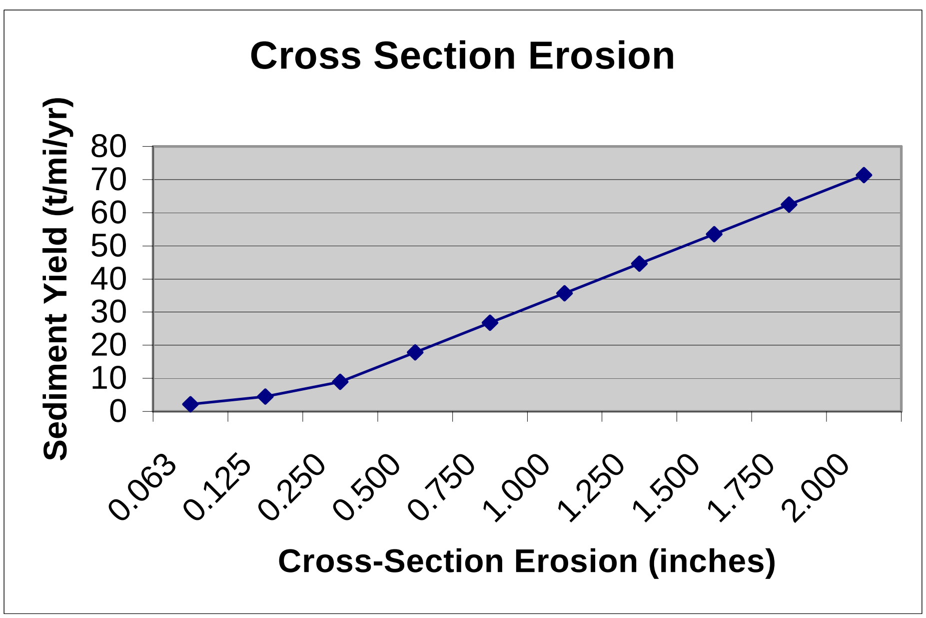

Figure F-2. Modeled Sediment Yield from Thickness of Cross-Section Erosion

The model does not consider sediment routing, nor does it attempt to estimate the erosion to streambeds and banks resulting from localized sediment deposition in the streambed. The model does not attempt to measure the effects of additional water capture at road crossings. It is assumed, that on the balance, the additional stream power created by additional water capture over a shorter period would increase net export of sediment, even though some erosion would be caused by this watershed effect.

Assessment of Model's Conservative Estimate:

Several conservative assumptions were made in the model construction, which cause it to develop conservatively high estimations of sedimentation in the streams modeled. These assumptions are listed in the following paragraphs and a numerical assessment of the magnitude of the conservatism is assigned.

The model uses RUSLE 2 and forest sediment yield coefficients to develop land use sediment delivery estimates. The output values are treated as delivery to the stream. The RUSLE 2 assumes delivery if the slope assessed is immediately up gradient from the stream system. This is not the case on the majority of the agricultural land assessed. Estimates made in the Lake Creek Sediment Study indicate that, at most, 25% of the erosion modeled was delivered as sediment to the stream (Bauer, Golden, and Pettit 1998). A similar local estimate has not been made with sediment yield coefficients, but it is likely that this estimate would be 25% as well. The land use model component is 75% conservative.

The roads crossing component of the model assumes 100% delivery of fine sediment from the 200 feet on either side of a stream crossing and road encroachment of 200 feet upon the stream channel. It is more likely that some fine sediment remains in ditches. A reasonable level of delivery is 80%. The model is likely 20% conservative in this component. On Belt terrain, use of the McGreer model is conservative. Since the sediment yield coefficients measured in-stream for Kaniksu granites are 167% of the coefficient for Belt terrain, this factor is estimated to be 67% conservative.

Fill failure data is developed from actual CWE field assessments. The CWE assessment does not assess all the roads in the watershed. The percentage of watershed roads assessed varies, but it is commonly 60% or less of the watershed roads. The model is 40% conservative in this component. Table F-1 summarizes the conservative assumptions and assesses its numerical level of overestimation.

Table F-1. Conservative estimate of stream sedimentation provided by the sediment model.

Model Factor	Kaniksu Granites (% conservative)	Belt Supergroup (% conservative)
100% RUSLE 2 and forest land sediment yield delivery	75%	75%
Crossing delivery	29%	20%
McGreer model	0%	67%
Road encroachment at 50 feet	20%	20%
Road failure	40%	40%
Total assessment of overestimate	**164%**	**231%**

The model provides an overestimate by factors of 1.6 and 2.3 for the Kaniksu and Belt terrain, respectively. This overestimation is a built-in margin of safety of 231%.

Model Verification:

Attempts to verify similar modeling approaches used in the Kootenai and Moyie Rivers sediment TMDL have been conducted within the northern Idaho region. Verification of the model can be developed by comparing measured sediment loads with those predicted by the model. For example, the United States Geological Survey measured sediment load at the Enaville Station on the Coeur d'Alene River during water year 1999. Based on these measured estimates, the sediment load per square mile of the basin above this point was calculated to be 28 tons (URS Greiner 2001). The middle value of the Belt geology sediment yield coefficient range is 14.7 tons per square mile. The model predicted a sediment yield of 33.6 tons/year for the entire subbasin. The agreement between the measured estimates and the modeled estimates is good.

Appendix F. References Cited

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